STATUS OF CLAIMS

The status of the claims is as follows:

Claims pending: 1, 3, 5-9

Claims amended: 1

Claims allowed: none

Claims objected to: none

Claims rejected: 1, 3, 5-9

Claims canceled: 2, 4, 10

STATUS OF AMENDMENTS

In response to the Office action dated 10/19/2006, please enter the following amendment and response. Claim 1 is amended to correct a grammatical error. An amendment, dated 10/9/2006, was filed within a Request for Continued Examination. An Office action responsive to the amendment continues to reject claims 1, 5-7 and 9 under 35 U.S.C. 103(a). The Office action does not provide any grounds for rejecting claims 3 and 8, which are still pending.

SUMMARY OF CLAIMED SUBJECT MATTER

The present invention relates to a mechanical returnless fuel system that utilizes pressure regulator such as a diaphragm-less pressure regulator in cooperation with a substantially constant output pump to provide a fuel pressure that varies as a function of the engine fuel demand.

According to the method as recited in claim 1, the present invention provides a method for providing fuel to an automotive engine. A mechanical

returnless fuel system is provided for supplying fuel to the fuel injectors and also includes a fuel pump having a pump output (Fig. 1, Par [0011]). The pump output is substantially constant [Par [0011], lines 7-8). The controller regulates an opening time for the fuel injectors to deliver the precise quantity of fuel (Par [0011], lines 10-12). A spring-type pressure regulating valve is provided within a fuel tank and returns a portion of the pump output to the fuel supply instead of to the fuel injectors (Par [0012], lines 1-9). The pressure regulating valve produces a fuel pressure that varies as a function of the engine fuel demand (Par [0012], lines 9-15). An estimated fuel pressure of the mechanical returnless fuel system is determined based on the projected fuel demand (Par [0013], lines 12-13). An opening time for the fuel injectors is determined based upon the estimated fuel pressure (Par [0011], lines 10-12).

According to the apparatus as recited in claim 6, the present invention provides a mechanical returnless fuel system that supplies fuel to the fuel injectors from a fuel supply (Fig. 1, Par [0011]). The mechanical returnless fuel system includes a fuel pump having a pump output ([Par [0011], lines 7-8). A fuel line connects the fuel pump to the fuel injectors. A spring-type pressure regulating valve is disposed within a fuel tank for returning a portion of the pump output to the fuel supply (Par [0012], lines 1-9). The pump output is substantially constant ([Par [0011], lines 7-8). A controller regulates the fuel injectors. The controller determines a projected engine fuel demand and determines an estimated fuel pressure based upon the projected engine fuel demand (Par [0013], lines 12-13). The controller also determines the opening time of the fuel injectors based upon the estimated fuel pressure (Par [0011], lines 10-12).

According to claim 3, a look-up table is provided for determining an estimated fuel pressure (Par [0013], lines 25-29).

According to claim 4, a fuel rail distributes fuel to the injectors where the estimated fuel pressure corresponds to the fuel pressure within the fuel rail.(Par

[0014], lines 5-6).

According to claim 7, the pressure regulator valve produces a fuel pressure in the fuel line that varies based on the engine fuel demand (Par [0012], lines 9-10).

According to claim 8, the controller includes a look-up table for determining an estimated fuel pressure (Par [0013], lines 25-29).

According to claim 9, the pressure regulator valve produces a fuel pressure in the fuel line that varies based on the engine fuel demand (Par [0012], lines 9-10).

None of the claims contain either a means plus function or a step plus function element.

GROUNDS OF REJECTION TO BE RECONSIDERED

1. Whether claims 1, 3, 5-9 are unpatentable under 35 U.S.C. §103(a) over Minagawa (US 5,715,797) in view of Powell (US 5,673,670).

ARGUMENT

Rejection of Claims 1 and 8 under 35 USC 103(a)

Claims 1 and 6

Claims 1 and 6 recite a method and apparatus, respectively, for operating an automotive engine including fuel injectors that open to deliver fuel to the engine. A mechanical returnless fuel system is provided for supplying fuel to the fuel injectors and also includes a fuel pump having a pump output. The pump output is substantially constant. The controller regulates an opening time for the

fuel injectors to deliver the precise quantity of fuel. A spring-type pressure regulating valve is provided within a fuel tank and returns a portion of the pump output to the fuel supply instead of to the fuel injectors. The pressure regulating valve produces a fuel pressure that varies as a function of the engine fuel demand.

Emphasis is placed on the limitations of a mechanical returnless fuel system, a pump having a constant output, and a spring-type pressure regulating valve.

Minagawa is an electronic returnless fuel pump system which includes a pulse-width modulated fuel pump. Minagawa changes the current provided to the fuel pump to increase/decrease the fuel pump output for controlling the fuel pressure provided to the fuel injectors without any need for a regulating valve. Fuel pressure is estimated based on the fuel flow supply rate which is controlled by the electric varying supply current, and as a result, Minagawa delivers the exact amount of fuel required by the injectors. Minagawa is an entirely different basic structure than the present invention. To suggest a mechanical returnless fuel system that provides the substantially constant pump output as recited in the present invention by referencing an electronic returnless fuel system which provides the exact amount of fuel supplied to the injectors by varying the pump output based on fuel demand is neither practical nor obvious to do.

Powell uses a conventional diaphragm-type pressure regulator that opens to relieve pressure. Such diaphragm-type regulators are very effective for maintaining a constant fuel pressure. However, such diaphragm-type regulators add significant cost to the fuel system. When a diaphragm-type regulator is used, a constant pressure is maintained in the fuel lines as illustrated by the ideal constant pressure curve 72 shown in Fig. 2 of the present invention.

The Office action states that the pressure regulator disclosed by the applicant appears to be no different from those suggested by Powell. The pressure regulator of the present invention does not utilize a diaphragm-type pressure regulator but rather a type of regulator not previously used in a mechanical returnless system. The regulator outputs a linear but non-constant pressure output as illustrated by the pressure curve 70 shown in Fig. 2. Powell's references three patents (US 5193576, US5163472, US 5193576) as examples of the conventional by-pass pressure regulators that are used in its system (see col. 2, lines 25-30). As stated earlier, the pressure regulator (23) of Powell provides a constant pressure whereas the pressure regulator of the present invention outputs a linearly varying, non-constant pressure. The linearly varying pressure has the advantage of varying the pressure in proportion to the engine fuel flow rate. As a result, the estimated fuel pressure based on the projected engine fuel demand provides a more accurate basis for determining the opening time for the fuel injectors and provides improved control of the automotive engine operation without requiring a fuel pressure sensor.

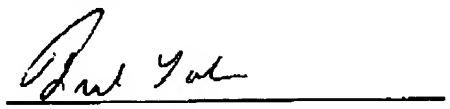
In summary, Minagawa and Powell in combination fail to teach or suggest each of the limitations of the present invention. Minagawa is an electronic returnless fuel system that varies the pumps output for providing the exact amount of fuel to the injectors, and such systems, are not energy efficient. Minagawa fails to teach or suggest a mechanical returnless fuel system. In addition, Powell fails to describe a spring-type pressure regulator having a linear but non-constant output that is disposed within the fuel tank. The present invention simplifies the fuel delivery system by utilizing simple and less expensive components that operate in a cooperative and nonobvious manner. Providing such a simplified system provides a novel and useful invention with reduced cost and complexity, and is energy efficient. The fuel delivery system of the present invention as a whole is neither shown by the prior art nor suggested by the prior

art. The Office action has individually referenced complex components and systems while suggesting that such complex components could be substituted to perform the functions of the present invention.

CONCLUSION

The final rejection has failed to describe or suggest the limitations of claims 1, 3, 5-9. The prior art relied upon in the final rejection neither teaches nor suggests the structure or function of the present invention. The final rejection for claims 1, 3, 5-9 fail to describe or suggest the limitations of the present invention. Moreover, claims 3, 5, 7-9 depend from claims 1 or 6 and are therefore allowable. Accordingly, the rejection contained in the Office action dated October 19, 2006, should be reversed.

Respectfully submitted,



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